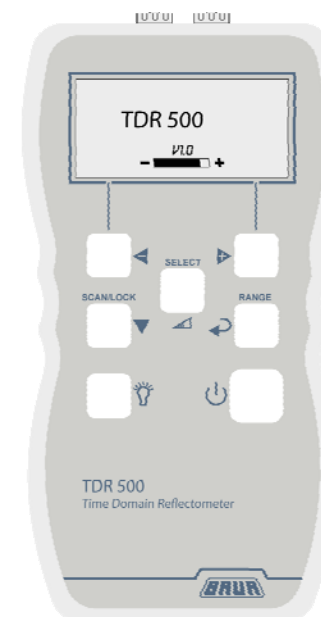


User manual

Handheld Time Domain Reflectometer

TDR 500



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11 DECLARATION OF CONFORMITY

We



BAUR Prüf- und Messtechnik GmbH
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declare, under our sole responsibility, that the BAUR product
BAUR Time Domain Reflectometer TDR 500

to which this declaration refers, conforms to the following standards or
standard documents:

- Low voltage guideline 2014/35/EU
EN 61010-1:2010
EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + AC:2011 +
A2:2013
- EMC Guideline 2014/30/EU
EN 55022:2010
EN 61000-4-2:2009
EN 61000-4-3:2006 + A1:2008 + A2:2010
EN 61000-4-4:2012
EN 61000-4-5:2006

Signed: Torsten Berth, Technical Director
 Dr. Eberhard Paulus, Director QM/QS

Sulz, 30.01.2015

General

Battery	4 x 1.5 V alkaline batteries IEC LR6
Automatic switch off	1, 2, 3 min or deactivated
Display	LCD display (128 x 64 pixel), with background lighting
Ambient temperature	10 to +50 °C
Storage temperature	-20 to +70 °C
Dimensions (W x H x D)	Approx. 165 x 90 x 37 mm
Weight	Approx. 350 g (12 oz.)
Degree of protection	IP 54
Safety and EMC	CE-compliant in accordance with Low Voltage Directive (2014/35/EU) and EMC Directive (2014/30/EU)

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We reserve the right in the interests of our customers to make amendments as a result of further technical development. Illustrations, descriptions and scope of supply are therefore not binding.

The names of products and companies are the trademarks or brand names of the relevant companies.

10 DELIVERY SCOPE AND OPTIONS

Standard delivery

- BAUR handheld time domain reflectometer TDR 500
- Connection cable with 2 crocodile clips
- Carrying bag incl. carrying strap
- User manual

9 TECHNICAL DATA

Cable fault location

Output pulse	5 V _{peak-to-peak} (in open circuit)
Output pulse width	3 ns – 3 ms
Output impedance	25, 50, 75 or 100 Ω; adjustable
Overvoltage protection	AC 250 V
Sampling rate	2 measurements/s or single measurement (not in 3 km /6 km range)

Audio frequency generator: 810 – 1100 Hz

Measurement range	Metre (Feet)	Kilometre (Feet)
	7 (23)	1 (3,280)
	15 (49)	2 (6,560)
	30 (98)	3 (9,850)
	60 (197)	6 (19,000)
	120 (394)	
	250 (829)	
	500 (1,640)	

Measurement range selection: Manual

Propagation speed	Adjustable: between 1 – 99% as velocity factor (ratio of the transmitted pulse speed to the speed of light) in m/μs or ft/μs (displayed as v/2)* *The conversion is based on the value Vp % UC (accuracy ±1 digit).
Resolution	Approx. 1% of measurement range
Accuracy	1% of selected measurement range (at homogeneous propagation speed)

8 TRANSPORTATION AND STORAGE

8.1 Transportation

If you are sending the TDR 500 to BAUR Prüf- und Messtechnik GmbH, a BAUR representative or to the technical service for repairs, observe the following:

- ▶ During transport, comply with the ambient conditions specified in the technical data of the product. Information on the technical data is given in the corresponding chapter of this user manual.
- ▶ Protect the device against strong vibrations.
- ▶ Protect the device against humidity.

8.2 Storage

- ▶ During storage, comply with the ambient conditions specified in the technical data of the product. Information on the technical data is given in the corresponding chapter of this user manual.
- ▶ Protect the device and its components from humidity.
- ▶ If the instrument is not to be used for a period of more than 60 days, it is recommended that the batteries are removed and stored separately.

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3. Use a soft cloth lightly dampened with soapy water, wipe over the instrument, rinse the cloth in clean water squeezing out any excess water, wipe over the instrument removing any soap residue, dry instrument with a dry cloth.

7 TROUBLESHOOTING

NOTICE

Damage to devices due to improper handling.

The user is liable for damages caused due to improper maintenance or care.

- ▶ Never take apart the device. This can lead to damages to the device. Inside the device there are no components that could be serviced or repaired by the user.
- ▶ Repair work must be carried out only by qualified and authorised personnel from BAUR.

The instrument contains static sensitive devices and is not user serviceable. If an instrument fails, or its protection has been impaired, it should not be used but sent back for repair by suitably trained and qualified personnel.

When a fault occurs, proceed as follows:

1. Check the charge status of the device battery.
2. Restart the device.
3. If the error occurs again after the device has been restarted, contact your nearest BAUR representative (<http://www.baur.eu/baur-worldwide/>).

It may be possible for the BAUR Prüf- und Messtechnik After Sales Service Team to determine the cause of the fault remotely. To do so, please specify the following data:

- Device serial number
- Firmware version
- Procedure that caused the error.

6 MAINTENANCE

NOTICE

Damage to devices due to improper handling.

The user is liable for damages caused due to repairs.

- ▶ Never take apart the device. This can lead to damages to the device. Inside the device there are no components that could be serviced or repaired by the user.
- ▶ Maintenance work must be carried out only by qualified and authorised personnel from BAUR.

6.1 Battery replacement

1. Disconnect the instrument from any cable or network link.
2. Turn the instrument off.
3. Loosen the two black screws and remove the battery compartment cover.
4. Replace the batteries with 4 x 1.5 V alkaline batteries, observing the polarities.
5. Refit the battery compartment cover and refit the two screws.

6.2 Cleaning

NOTICE

Damage to devices due to improper handling.

- ▶ Do not use alcohol, solvents or hydrocarbons.
- ▶ Ensure material compatibility.
- ▶ Do not splash water directly on the instrument

1. Disconnect the instrument from any source of electricity.
2. Turn the instrument off.

1 GENERAL

1.1 Using this manual



- ▶ Read the entire user manual before operating the product for the first time.
- ▶ Consider this user manual as part of the product and keep it in an easily accessible location.
- ▶ This user manual contains all necessary information that is needed for the fault location with TDR 500.
- ▶ If this user manual is lost, please contact BAUR Prüf- und Messtechnik GmbH or your nearest BAUR representative (<http://www.baur.eu/baur-worldwide/>).

1.2 Application of instructions

This user manual applies for devices with the firmware version from 2.02.

1.3 Structure of safety instructions

The safety instructions in this user manual are presented as follows:

Danger symbol	 SIGNAL WORD
	Type of danger and its source Possible consequences of violation. ▶ Measure to prevent the danger.

If a dangerous situation could arise at a specific step, the safety instruction is displayed immediately before this dangerous step and is shown as follows:



SIGNAL WORD




Type of danger and its source

Possible consequences of violation.



- Measure to prevent the danger.

Danger levels

Signal words in the safety instructions specify the danger levels.

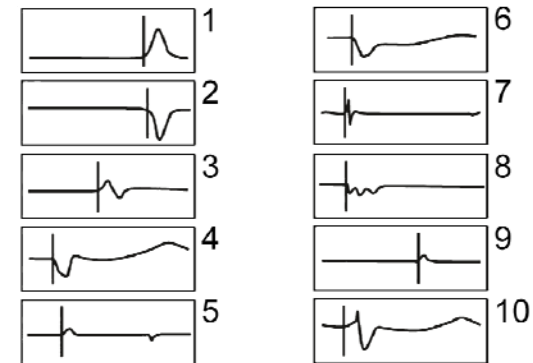
 DANGER	Will lead to severe injuries or death.
 WARNING	May lead to severe injuries or death.
 CAUTION	May lead to light to moderate injuries.
NOTICE	May lead to material damage.

Danger symbols

	General danger
	Risk of electric shock

5.7 Typical fault displays

The following diagrams show typical fault traces to assist you in the identification of faults using the TDR 500:



Nr.	Fault		
1	Open conductor	6	Wet splice/water
2	Shorted conductor	7	Frayed cable
3	Splice	8	Water ingress
4	Bridge tap	9	Tap
5	Split/resplit	10	Splitter

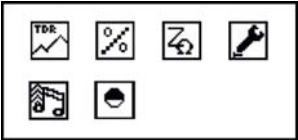
5.8 Typical cable Vp and impedance values



Type	Vp	Z	Type	Vp	Z
Cat5 STP	72	100	T/Pair Jelly PE	64	100
Cat5 UTP	70	100	T/Pair PE	67	100
Coax Air	98	50/75	T/Pair PTFE	71	100
Coax Air Space	94	50/75	T/Pair PVC	58	100
Coax Foam PE	82	50/75	T/Pair Paper 72nF	88	100
Coax Solid PE	67	50/75	T/Pair Paper 83nF	72	100

5.5 Tone generator

The TDR 500 may also be used as a tone generator to trace and identify cables and wires. The user will need a conventional inductive tone probe within the range 810 Hz to 1,110 Hz.

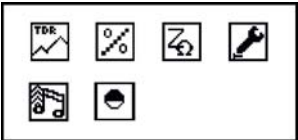
Selecting tone generator (Level 2)





- 1. Press ◀ or ▶ to select .
- 2. To open the  menu press **SELECT**.
- 3. To exit press ↶.
- 4. When tone has been selected, connect test lead to cable pair to be traced.
- 5. Trace the cable using tone probe which will emit a tone. The volume will increase the nearer the probe is to the cable.


Note: The auto shutdown function is disabled in tone generator mode so that the tone can be injected into a cable for extended periods while tracing takes place.

5.6 Set contrast



- 1. Press ◀ or ▶ to select .
- 2. To open the  menu press **SELECT**.
- 3. Press ◀ or ▶ to increase or decrease contrast.
- 4. To exit press ↶.

1.4 Symbols used

Symbol	Meaning
▶	You are prompted for an action.
1. 2. [...]	Perform the actions in this sequence.
a. b. [...]	If an operation consists of several operating steps, specify these with "a, b, c". Perform the operating steps in this sequence.
1 2 [...]	Numbering in the legend
▪	List
	Indicates extensive information on the topic in the corresponding user manuals.

1.5 Information on the screenshots and graphics used

The screenshots and graphics used are intended to illustrate the procedure and may therefore differ slightly from the actual state.

1.6 Warranty

For warranty claims, please contact BAUR Prüf- und Messtechnik GmbH or your local BAUR representative (<http://www.baur.eu/baur-worldwide/>). Warranty is cancelled in case of misuse.

1.7 After Sales Service

For questions contact BAUR Prüf- und Messtechnik GmbH or your BAUR representative (<http://www.baur.eu/baur-worldwide/>).

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2 FOR YOUR SAFETY

All BAUR devices and systems are reliable and are manufactured as per state-of-the-art technology. The individual parts and the finished devices are subject to continuous testing by our qualified personnel as part of our quality assurance system. Each device is fully tested before delivery.

However, the operational safety and reliability in practice can be achieved only when all necessary measures have been taken. The responsible body¹ and operator² of the device or system are responsible for planning these measures and monitoring their implementation.

Before operating the device or system you should read and understand this user manual and the user manuals of all integrated devices.

2.1 Instructions for the user

The product may be operated only by authorised and trained electrical engineers. An electrical engineer is a person who owing to his professional education (electrical engineering), knowledge, experience and acquaintance with the applicable standards and regulations can assess the tasks assigned to him and detect possible dangers.

In addition, the user must have:

- Knowledge of the technical equipment and operation of TDR 500
- Knowledge of the testing and measurement procedures
- Knowledge of plant engineering (cable types, switchgear, etc.).

On the fault display shown above a low impedance fault occurs at 64 meters shown by a negative spike, and high impedance at 129 meters. To increase the gain of the return pulse see chapter 5.4. The open end of the cable is shown as a large positive spike, this is used to determine the end of the cable route and the overall length of the cable being 180 meters.

5.2 Selecting range scales

The TDR 500 has 11 range scales covering the range of 7 to 6,000 meters.

- ▶ To select a range scale, or scan the cable route, press and hold down the **RANGE** button and press ◀ to decrease range, press ▶ to increase range.

5.3 Single shot and continuous scanning modes

Single shot mode: Saves on battery life and also enables the TDR 500 to be disconnected from the cable while still leaving the fault display on the screen

When the TDR 500 is first switched on, it is set to “Single shot” mode. In this mode the TDR 500 only fires a pulse into the cable under test when either the ◀ and ▶ buttons or ▼ button is pressed.

Continuous scanning mode: Fires pulses into the cable under test. In this mode the TDR 500 is able to more easily identify intermittent cable faults.

- ▶ To enter “Continuous scanning” mode press down and hold the ▶ button.

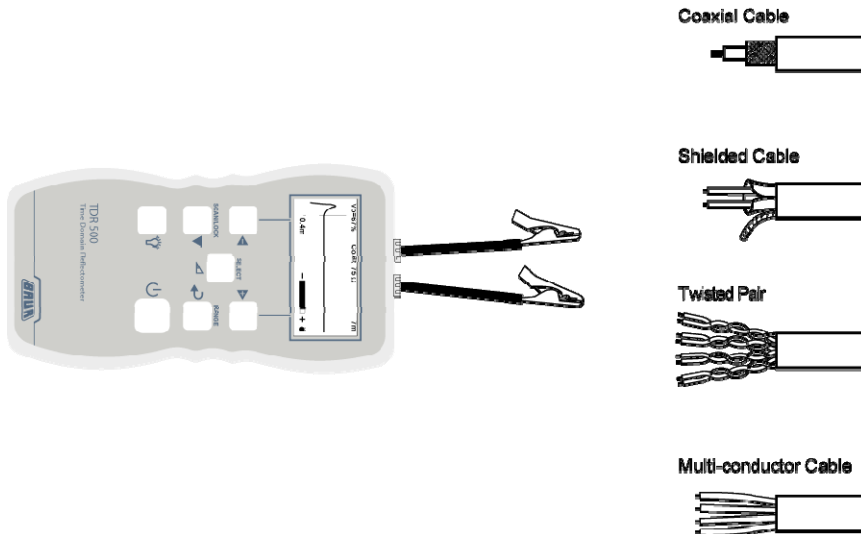
The 📶 icon will appear at the bottom right of the display, when continuous scanning mode is activated.

5.4 Gain adjustment

1. To increase the gain of the return pulse, align the cursor at the beginning of the event.
2. Press and hold 🔍 button and press ◀ or ▶ keys to increase or decrease gain.

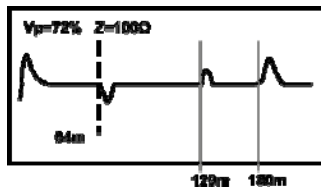
¹ Responsible body is the person or group that is responsible for the safe operation of the device and its maintenance (EN 61010-1, 3.5.12).

² Operator is the person who uses the device for its intended purpose (according to the definition of user in compliance with EN 61010-1, 3.5.11).



5.1 Testing a cable

Having followed the set up procedures in the preceding chapters, a typical display showing impedance anomalies is shown below. Further examples are shown in chapter 5.7 (page 25).



1. To determine the distance move the vertical cursor line left or right along the line of the trace to the event by pressing ◀ or ▶.
2. Position the cursor at the beginning of the event and read off the distance at the bottom left corner.

2.2 Intended use

The BAUR handheld time domain reflectometer TDR 500 is used for fault location in all metal cables such as power cables, coaxial cables, data cables and communication cables. The TDR 500 is designed for use on de-energised circuits only.

This device meets the immunity requirements of telecom networks according to EN 61326-1.

If the device is used without observing this condition, safe operation cannot be guaranteed. The operator or user is liable for any damage to persons and property resulting from incorrect operation.

Proper use also includes

- Compliance with all instructions in this user manual,
- Compliance with the technical data and connection requirements given on the rating plate and in the user manual,
- Compliance with the inspection and maintenance tasks.

2.3 Avoiding dangers, taking safety measures

- ▶ When installing the test system and operating the TDR 500 observe the following rules and guidelines:
 - Accident prevention and environment protection rules applicable for your country
 - Safety instructions and regulations of the country where TDR 500 is being used (according to the latest version)
 - EU/EFTA countries: EN 50110 "Operation of electrical installations"
Other countries: The standards for operating electric systems applicable in your country
 - If necessary, other national and international standards and guidelines in the latest applicable version
 - Local safety and accident prevention regulations
 - Employers' liability insurance association regulations (if any)

Technically secure state of the device

Safety, function and availability depend on the proper condition of the device. Upgrades, modifications or alterations to the product are prohibited.

- ▶ Operate the device only in a technically perfect condition.
- ▶ In the case of damage and/or malfunction, immediately stop the device, identify accordingly and have the faults rectified by appropriately qualified and authorised personnel.
- ▶ Comply with the inspection and maintenance conditions.
- ▶ Use only accessories and original spare parts recommended by BAUR. The use of spare parts, accessories and optional extras that are not tested and approved by BAUR could adversely affect the safety, function and characteristics of the product.
- ▶ Never take apart the device. The device does not contain any components that could be serviced or repaired by the user.

2.3.1 Dangers when working with high voltage

Although this device does not produce dangerous voltages, the electric circuits to which it is connected could present danger of electric shock or formation of electric arcs.

The personnel need to pay special attention and must be very careful while working with high electric voltage.



Commissioning and operation of TDR 500 are permitted only in compliance with the EN 50110 (EU/EFTA countries) or with standards applicable in your country.

Observe 5 safety rules

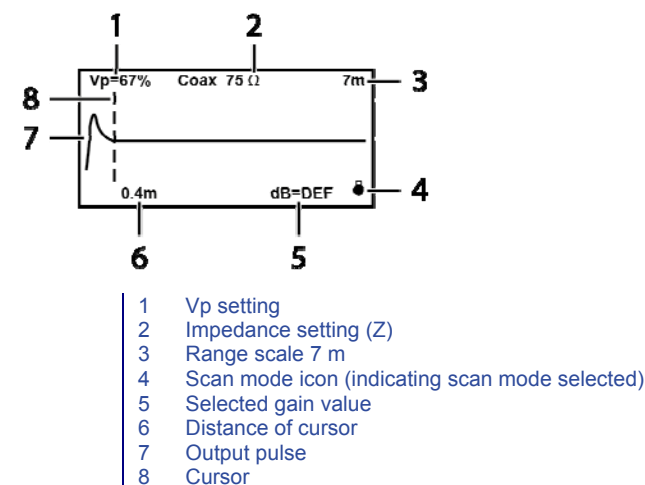
Comply with the following safety rules before beginning tasks in and on electrical plant:

- ▶ Disconnect the test object.
- ▶ Secure against re-energisation.
- ▶ Ascertain the voltage status of the disconnected object.
- ▶ Short-circuit the test object to earth.
- ▶ Protect or isolate the test object from adjoining live HV plant.

5 USING THE TDR 500

	 DANGER
	<p>Dangerous electric voltage</p> <p>Danger to life or risk of injury due to electric shock.</p> <ul style="list-style-type: none"> ▶ Before test connections are made, switch off, de-energise and isolate the circuit under test.

1. Upon completion of the set up procedures in chapter 4, press button ▼ and the following test screen will be displayed



2. Attach the test lead set to the TDR 500 via the connectors located at the top of the unit.
3. Ensure that no power supply or equipment is attached to the cable to be tested.
4. Ensure that the far end of the cable under test is open or shorted (not fitted with a resistive termination)
5. Attach the TDR 500 to one end of the cable to be tested

4.7 Set contrast



1. Select using the keys.
2. Press **SELECT** key to open.
3. Press or to select .
4. To open the menu press **SELECT**.
5. Press or to increase or decrease contrast.
6. To exit press .

4.8 Backlight

The LCD display is fitted with an LED backlight to enable easy viewing under a variety of different lighting conditions. The backlight is switched on and off with the key.

4.9 How to determine Vp settings

If the TDR 500 is to be used with a cable type for which the Vp is unknown, this must first be determined.

1. Take a sample of the cable at least 100 m or 300 ft long.
2. Measure the actual length of cable using a rule or tape measure, or some other reliable method.
3. Connect the TDR 500 and adjust the Vp setting such that the tester gives a correct reading of the sample length.

	DANGER
<p>High electric voltage</p> <p>Danger to life or risk of injury due to electric shock</p> <ul style="list-style-type: none"> ▶ Before commencing work, the operator must assess the risks for the specific working conditions. Protective measures are based on the risk assessment and must be followed at the workplace. ▶ The TDR 500 is designed for use on de-energised circuits only. The circuit under test must be switched off, de-energised, securely isolated and proved safe before test connections are made. <p>Connection to lines under voltage will damage the instrument and could be hazardous to the operator</p> <ul style="list-style-type: none"> ▶ Always keep your hands behind guards on the probes and crocodile clips. ▶ Connect the device as described in this user manual. ▶ Before lifting the safety measures, all live parts must compulsorily be discharged, earthed and short-circuited. 	

3 PRODUCT INFORMATION

The TDR 500, 6 km (19,000 ft.) range handheld time domain reflectometer weighing only 350 grams (12 oz.) fits neatly into the hand. With its 128x64 pixel backlight display, provides accurate and easy to read fault locations on metallic cables. With a 3 nanosecond pulse rise time, "near end" cable faults can be clearly identified without the need to suppress the transmitted pulse. Housed in a rugged IP 54 rated ABS enclosure, the TDR 500 is suitable for outside use.

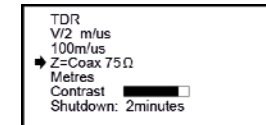
Using pulse widths and gain settings which are pre-determined for the length range selected and with only 7 operating buttons, all major operating and setting parameters can be easily accessed. In addition to the pre-determined gain settings there is a user variable gain control to further enhance the displayed trace. A 6 km cable route can be scanned in seconds, allowing the operators a view of the cable route, yet arriving quickly to the fault. By using the TDR 500 scan lock facility, cable can be continually scanned or the trace held for closer analysis. To enable the TDR 500 to test all metallic cables, four user selectable output impedances are provided 25, 50, 75 and 100 ohms.

Faulty cables may be traced using the TDR 500 warble tone feature, an oscillating tone is injected into the suspect power or transmission line and by using a commercially available tone tracing probe the suspect line can be identified.

3. Press ▼ to move ➡ to unit of measure (feet or meters).
4. Press ◀ or ▶ to scroll between feet and meters.
5. To exit press ↶. Selected values will be automatically stored.

Note: When unit of measure has been selected, this will automatically change the V/2 figure, which will also be displayed in the selected unit of measure (ft./m).

4.5 Set cable impedance (Z)

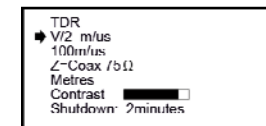


1. Select [Z] using the ◀▶ keys.
2. Press **SELECT** key to open.
3. Press ▼ to move ➡ to Z.
4. Press ◀ or ▶ to scroll between values.
5. To exit press ↶.
Selected values will be automatically stored.

4.6 Set velocity of propagation (Vp)

Velocity of propagation (Vp) may be set as % UC or speed in micro seconds (μs). The unit of measure, the speed is displayed in (feet or meters), will be determined by the setting selected in chapter 4.4.

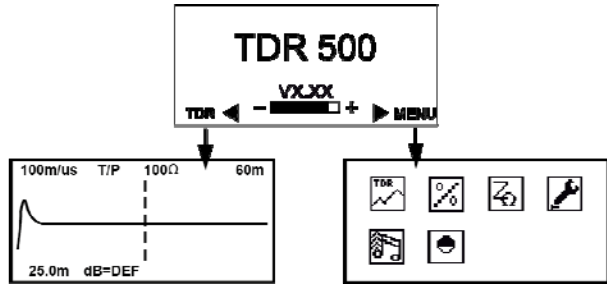
The conversion is based on the value Vp % UC (accuracy ±1 digit).






1. Select [Vp] using the ◀▶ keys.
2. Press **SELECT** key to open.
3. Press ▼ to move ➡ to displayed unit.
4. Press ◀ to scroll between **V/2 m/us** or **Vp % UC**.
5. Press ▼ to move ➡ to displayed value.
6. Press ◀ or ▶ to increase or decrease displayed value.
7. To exit press ↶.
Selected values will be automatically stored.

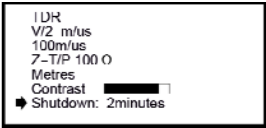
Level 2: Menu

1. To access level 2 Menu press  and release.











2. To change the following settings from menu, select  using the   keys.
3. Press **SELECT** key to open.

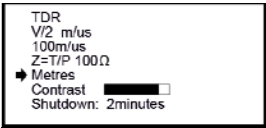
4.3 Set auto shutdown



To preserve battery life, the TDR 500 is fitted with an auto shutdown feature. Shutdown time is selectable between disabled 1 minute, 2 minutes and 3 minutes.

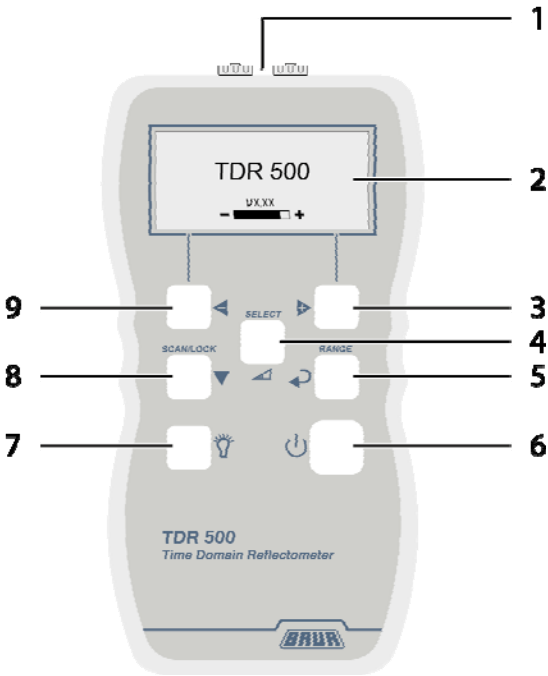
1. Select  using the   keys.
2. Press **SELECT** key to open.
3. To change settings press  to move  to shut down.
4. Press  or  to select setting.
5. To exit press . Selected values will be automatically stored.
- Note:** The shutdown feature isn't active if the settings menu is open.

4.4 Set unit of measure



1. Select  using the   keys.
2. Press **SELECT** key to open.

3.1 Full illustration



Nr.	Element
1	Connections for measuring cables
2	LCD display
3	Menu/Cursor right button / increase range
4	Select/Gain button
5	Back/Measuring range button
6	Power on/off button
7	Backlight on/off button
8	Start test button
9	TDR/Cursor left button / decrease range

3.2 Accuracy


The TDR 500 is able to measure distances to faults and cable lengths to an accuracy of +/- 1%. This measurement accuracy is based on the correct velocity of propagation (Vp) value being used for the cable under test, and homogeneity of the Vp along the cable length. If the Vp is set incorrectly by the operator, or the Vp varies along the length of the cable, then additional errors will be incurred and the measurement accuracy will be affected.

Note: The Vp is less well defined with unshielded multicore cable, including power cable, and is lower when a cable is tightly wound on a drum than when installed.

4 FIRST OPERATION

- ▶ Observe the following information:
 - The safety instructions in the chapter *For your safety* (on page 10)
 - Local safety and accident prevention regulations
 - Safety instructions and regulations according to the state-of-the-art
 - National and international standards and guidelines in the latest applicable version:
EN 50110 for operation of electric systems (EU/EFTA countries);
or applicable standards in your country.

4.1 Preparing the TDR 500 for use

- ▶ Press  button to power the tester, the following screen will be displayed:



No.	Element
1	Model
2	Battery condition indicator (all black battery, fully charged, as charge decreases symbol changes to white).
3	Software version programmed into device

Prior to use the following parameters will need to be set

- Set auto shutdown: chapter 4.3 (page 18)
- Set contrast: chapter 5.6 (page 24)
- Set unit of measure: chapter 4.4 (page 18)
- Set velocity of propagation: chapter 4.6 (page 19)

4.2 Menu and screen displays

Level 1: Start-up screen

